It is easy to see, from an inspection of Diagram No. 1, that a portion of such an equilateral hyperbola would coincide nearly with the true curve, and with the points determined by experiment.

Addendum.—Mr. Robert B. Hayward, of Harrow, has kindly called my attention to an error in my application of Law 1 to Mr. Jevons' first series of experiments in which different weights were thrown by hand. In applying Law 1 to these experiments, I assumed, in equations (1, 2, 3, 4), that the total work stored up in a revolving body is that of a body of equal weight, moving with the velocity of the centre of *oscillation.* I should have stated that it is the work of a body of equal weight moving with the velocity of the centre of *gyration.* If this error be corrected, the four equations become much simpler in form, and lead directly to the empirical formula used by Mr. Jevons, and also furnish a curve which corresponds very well with the experiments.

Let k denote the radius of gyration, and let the other symbols remain as before; we find the following equations, which are to be used instead of the first four already given.

$$(w + x)\, v^2 = \text{Const.} \qquad (1)$$

$$v = V\frac{k}{a} \qquad (2)$$

$$\frac{k^2}{a^2} = \frac{1}{3} \cdot \frac{3\,w + x}{w + x} \qquad (3)$$

$$(3\,w + x) \times R = A \qquad (4)$$

Mr. Jevons' eight experiments furnish twenty-eight equations to determine the value of x, and the mean of all the values is

$$x = 11{\cdot}1\text{lb.}$$

This value of x, when substituted in the eight equations furnished by (4), gives us the following values of A.

w	A
56 lbs.	329·5
28 „	351·8
14 „	364·2
7 „	338·9
4 „	337·5
2 „	318·9
1 „	325·0
½ „	342·1
Mean	338·49

If the mean values of A and x be used in equation (4), we find the following comparison of theory and observation:—

w	R (*observed*).	R (*calculated*).	*Difference.*
56 lbs.	1·84 feet	1·89 feet	−0·05 feet
28 „	3·70 „	3·56 „	+0·14 „
14 „	6·86 „	6·37 „	+0·49 „
7 „	10·56 „	10·55 „	+0·01 „
4 „	14·61 „	14·65 „	−0·04 „
2 „	18·65 „	19·79 „	−1·14 „
1 „	23·05 „	24·01 „	−0·96 „
½ „	27·15 „	26·86 „	+0·29 „

The curve of useful effect, deduced from equation (4) is

$$w\,R = \frac{A\,w}{3w + x}.$$

This curve represents an equilateral hyperbola, whose equation, referred to its asymptotes as axes of co-ordinates, is

$$x\,y + 417{\cdot}4 = 0.$$

Diagram No. 4 shows this hyperbola, while the centres of the little circles show the several experiments.

This hyperbola, derived from the property of the centre of gyration, represents the observations very well; and it nearly coincides with the more complex curve derived from the centre of oscillation, shown in Diagram No. 1.

Mr. Jevons' empirical formula corresponds at once to equation (4), provided the quantity (q) be used to denote *one-third* of the weight of the arm instead of *one half.* His formula becomes, multiplying above and below by 3,

$$R = \frac{347{\cdot}1}{3w + 11{\cdot}7}$$

The weight of the arm and shoulder used in throwing weights, viz. 11·1lb. or 11·7lb., is considerably greater than the weight of the simple arm, 7·4lb., a result quite consistent with the fact that the scapular muscles move with the arm in this kind of exertion.

S. HAUGHTON

NOTES

AT a preliminary meeting held at King's College on Monday last, the Rev. Dr. Barry, Principal, in the chair, it was resolved that a fund for a Memorial to the late Dr. Miller, in connection with King's College as having been for thirty years the principal sphere of his labours, be at once raised by subscriptions in the College, and from the general public. It was further resolved to form a committee for the purpose of carrying out this resolution, and as soon as the committee is complete a meeting will be summoned to adopt such further measures as are necessary.

WE are glad to hear that Prof. Frankland has accepted the Presidency of the Chemical Society for the ensuing session.

A CIRCULAR has been issued by the Science and Art Department of the Committee of Council on Education, South Kensington, directing that in future all teachers certificated by the Education Department shall be allowed to earn payments on the results of the instruction of their pupils in Stage I. of Mathematics, according to the rules of the Science Directory, without having previously passed the qualifying examination required by § XXXIII. The Department has also issued the following amended programme of the examinations for the diplomas of the Royal School of Naval Architecture and Marine Engineering, which is to come into force at the examination to be held in April 1872, the examination in April 1871, being held according to the programme contained in the existing Directory of the School:—"Diplomas will be given to all persons, whether they have received their instruction at the school or not, who pass the final examinations of the school, provided that they give satisfactory evidence of having gone through the course of practical work recommended by the Council of the Institution of Naval Architects. These diplomas will be of two grades, according to the success of the candidate in the examination, the title of the higher grade being Fellow, and of the lower, Associate, of the Royal School of Naval Architecture." These examinations will be held annually towards the end of April. Candidates who have not been students of the school will be required to produce certificates that they have been engaged for three years, at least, in—(1) practical wood or iron ship-building in a dockyard; or (2) practical engine and boiler building in a dockyard, or in the works of a marine engineer; or (3) practical work as a draughtsman in a dockyard (or marine engine works), during which the candidate must have himself gone through the complete formation of the design of a ship (or of a marine engine), with the whole of the calculations included in it. Such candidates will also be required to give references as to character and good conduct before they are admitted to the examination. All such candidates must apply to the Secretary, Science and Art Department, South Kensington, W., not later than the 15th March in each year.

IN our notice last week of the attainments of the Senior Wrangler, we should have included the statement which we made some time since, that Mr. Hopkinson took the degree of D.Sc. at the University of London, in 1870, in two distinct branches, viz. Mathematics and Physical Optics, this being the first similar instance on record. Dr. Hopkinson has also attained the additional distinction which so often falls to the lot of Senior Wranglers, that of First Smith's Prize-man. The Second Smith's Prize has been awarded to Mr. Temperley, of Queen's College, bracketed fourth wrangler. It is stated that Dr. Hopkinson, being disqualified as a Nonconformist from sharing in the emoluments of the University, intends following his father's profession of engineer.

THE following are the Council and Officers of the new Anthropological Institute of Great Britain and Ireland:—President: Sir John Lubbock, Bart., F.R.S.; Vice-Presidents: Prof. Huxley, F.R.S., Prof. Busk, F.R.S., Mr. John Evans, F.R.S., Dr. Charnock, Dr. Barnard Davis, F.R.S., Mr. George Harris; Director: Mr. C. Staniland Wake; Treasurer: Mr. J. W. Flower, F.G.S.; Council: H. G. Bohn, Colonel Fox, Dr. Hyde Clarke, W. Blackmore, W. Boyd Dawkins, F.R.S., R. Dunn, David Forbes, F.R.S., T. M'K. Hughes, Dr. A. Campbell, S. E. Bouverie Pusey, W. C. Dendy, Sir D. Gibb, Bart., Dr. R. King, Capt. Bedford Pim, R.N., Rev. D. I. Heath, Dr. J. Beddoe, Dr. George Harcourt, Joseph Kaines, F. G. H. Price, and C. Robert des Ruffières. Secretary: J. F. Collingwood; Sub-editor of Journal: F. W. Rudler. A Special General Meeting of the Anthropological Society will be held at the rooms, No. 4, St. Martin's Place, on the 14th February, at half-past seven o'clock, for the purpose of authorising the trustees of the Society to transfer its funds and effects to the trustees of the "Anthropological Institute of Great Britain and Ireland," in pursuance of an agreement for union under that name between the Anthropological and the Ethnological Societies of London. On the same evening, at eight o'clock, will be held the first ordinary meeting of the Anthropological Institute, when Sir John Lubbock, Bart., President, will read a paper "On the Development of Relationships."

THE Anniversary Meeting of the Royal Astronomical Society will be held to-morrow at three, and that of the Photographic Society on Tuesday next at eight.

THE following lectures on Comparative Anatomy are to be delivered in the Theatre of the Royal College of Surgeons on Mondays, Wednesdays, and Fridays, at four o'clock, commencing on Friday, Feb. 17, by W. H. Flower, F.R.S., Hunterian Professor of Comparative Anatomy and Physiology. Eighteen lectures on the Characters, Structure, Functions, and Modifications of the Teeth and Allied Organs in the Mammalia. Essential characters and structure of teeth. Development and succession of teeth. Classification and nomenclature of teeth—Dental formulæ. Modifications of the characters of the teeth in the different groups of the mammalia. Teeth of Man. Teeth of *Simiina*—Old-World Monkeys and New-World Monkeys. Teeth of *Lemurina*. Teeth of terrestrial *Carnivora*—Dogs and allied forms; Cats and allied forms; Bears and allied forms. Teeth of *Pinnipedia*—Sea-Bears and Seals; Walrus. Teeth of *Insectivora*—Hedgehogs, Moles, Shrews, &c.; Galeopithecus. Teeth of *Chiroptera*—Frugivorous Bats, Insectivorous Bats, Blood-sucking Bats. Teeth of *Rodentia*—Hares, Guinea Pigs, Porcupines, Rats, Squirrels, &c. Teeth of *Cetacea*—Odontocetes or Toothed Whales; Dolphins, Porpoises, Narwhal, Sperm-whale, Ziphius, and allied forms; Zeuglodonts; Mystacocetes or Whalebone Whales, rudimentary Teeth; Structure and function of baleen or whalebone. Teeth of *Ungulata*—Perissodactyles: ancient and modern forms, Palæotherium, Horse, Rhinoceros, Tapir; Artiodactyles: Pigs, Hippopotamus, Anoplotheridæ, Camels, Chevrotains, and Pecora (Deer, Giraffe, Antelopes, Sheep, Goats, and Oxen). Teeth of Hyrax, of Toxodon, of Typotherium, and other anomalous forms. Teeth of *Proboscidea*—Elephant, Mastodon, Dinotherium. Teeth of *Sirenia*—Dugong and Manatee. Teeth of *Edentata*—Sloths, Anteaters, Armadillos. Teeth of *Marsupialia*—Opossums, Thylacine, Dasyures, Perameles, Phalangers Kangaroos, Wombats; Fossil Marsupials. Value of dental characters in drawing inferences as to the affinities and habits of extinct animals. Horny teeth of *Monotremata*—Ornithorhynchus. The lectures are free to all who take an interest in the subject.

INTELLIGENCE has been received of the death of Dr. F. A. G. Miquel, Professor of Botany at the University of Utrecht and Director of the Botanic Gardens at Leyden, one of the few remaining distinguished systematic botanists on the Continent, and greatly esteemed by all scientific visitors to Holland for his generous hospitality and kindly nature. He was the author of several monographs, and had written largely on the botany of the Netherland-Indies, especially Java and Surinam; and also on that of Japan, which has been much worked out by Dutch naturalists; but will be best known by his magnificent "Annales Musei botanici Lugduno-batavi," in four folio volumes, with splendid illustrations. He was one of the foreign members of the Linnean Society of London.

A STATEMENT having appeared in the *Globe* that the M.A.'s of the University of London have made a representation to the authorities that the examinations for degrees are too stringent, and that it is probable that the standard will be lowered; we are authorised to state that the report is entirely incorrect; no such representation has been made, and no proposal for lowering the standard of the degrees is under the consideration of the Senate of the University.

IN consequence of a report made to the Senate of the University of London by the Examiners in Physiology, setting forth the insufficiency of the present *viva voce* examination as a test of the practical acquaintance of candidates with histology and practical physiology, an important alteration has been made in the regulations of the First Bachelor of Medicine Examination. The alteration will take effect in the year 1872 and subsequent years, and the Registrar has been directed to notify to the various medical schools in connection with the University, that the Candidates for the first Examination in Bachelor of Medicine will be required to pass a practical examination in Histology. The requisite provision is to be made in the University building for carrying out a plan which has been suggested by the Examiners, and approved of by the Senate, and of which the following outline is given by the *British Medical Journal*:—The candidates are to be examined in convenient batches, placed in a suitable room, fitted up with microscopes, glasses, reagents, needles, scissors, and razors. Each student is to have placed before him a few characteristic mounted specimens, and portions of fresh tissue or tissues prepared for minute examination, all numbered and carefully selected, and to be given three hours in which to examine and report upon the specimens presented to him, as well as to mount certain specimens of particular organs or tissues, as may be required by the Examiners. In this way, it is felt, the possession of mere book-knowledge by the candidate will be at once disclosed, and the physiological examination will be made a real and satisfactory one.

A ZOOLOGICAL RECORD ASSOCIATION has been established for the purpose of continuing the *Record of Zoological Literature* (an annual volume, containing an abstract of, and an index to, all that has been done in zoology during the previous year), which has been held in such high esteem by working zoologists that for some time past the British Association has been induced to vote an annual grant of 100*l.* in its support. Owing, no doubt, to the fact of its utility not being sufficiently known to the public, the undertaking has not hitherto proved a financial success. The new Association, which includes, we understand, all the leading zoologists of the country, hopes to have better luck, and in a few days it is expected that its programme will be before the world. Mr. Stainton, F.R.S., is the Secretary.

THE New York Association for the Advancement of Science has recently elected officers for the ensuing year, and the *American Chemist* notes that on looking over the list it finds that, among the names of fifteen officers, it does not recognise a single man of science. Six are clergymen, three are physicians. Though it is pleasant to see these men anxious to promote the cause of science, a little sprinkling of scientific men would tend to increase the confidence of the public in the discussions of the society.

THE *American Chemist* states that Prof. William Griffis, of Rutgers College, has gone to Japan as Professor of Chemistry and Natural Philosophy in the University of Japan.

THE following scientific appointments to American Colleges have recently been announced :—Mr. George C. Swallow, to the chair of Agriculture in the University of Missouri ; Mr. Charles H. Wing, to the Professorship of Applied Chemistry, Dr. Alonzo M. Chase, as Instructor in Analytical Chemistry, and the Rev. J. J. Brown, to the chair of Physics, in Cornell University ; Mr. T. H. Staver has been elected Professor of Agricultural Chemistry at Harvard University ; and Mr. Albert H. Chester has been appointed to the Childs Professorship of Agricultural Chemistry in Hamilton College.

THE Legislature of Colorado, at its last session, appropriated thirty-nine hundred dollars for a building for a school of mines. The corner-stone of that building was laid on Monday, August 15, 1870, by Bishop Randall, in the presence of a large assembly of people.

THE *Scientific American* states that the Board of Trade of the city of Buffalo has obtained a franchise and organised a company to be styled the Oxyhydrogen Gas Company, having for its object the introduction of the oxyhydrogen gas light into that city. A committee of investigation has visited the oxygen gas works in New York, and with the information thus obtained we are informed that the work is to proceed at once. It would appear that Buffalo is to be the first city in America to adopt this splendid light. The experiment is an important one, and its success will be watched with considerable interest by gas-consumers in this country and America.

IT may be interesting to record that during the two mid-winter months of December 1870 and January 1871, the average temperature of the air at Blackheath was, according to Mr. Glaisher's tables, exactly 5° F. below the mean of the last fifty years. On 46 days the temperature was below the average, and above the mean on only 16 days, the mean for the 24 hours having been below the freezing-point on 27 days. The lowest average was on December 25th, when it fell as low as 18·9°, or 18·7° below the mean of the last fifty years. During nearly the whole of January the weather was also exceptionally warm in the neighbourhood of London ; in the midland and eastern counties, the depression would be considerably greater.

THE *American Chemist* for January announces that it commences its existence with that number as an independent journal, devoted to Theoretical, Analytical, and Technical Chemistry. The articles, both extracted and original, among which is a curious one on Assaying one hundred and thirty years ago, promise a supply of varied and useful information. It proposes to present its readers with abstracts of all papers published in America or elsewhere, which involve chemical principles in their discussion.

THE *British Medical Journal* states that two additional cases illustrating the efficacy of the injection into the veins of ammonia in snake-bite, on the plan of Professor Halford, are published in the Melbourne papers. They are reported with great decision of statement as to the immediate benefits conferred, but without the scientific precision of detail which is needed, and which will, we hope, be forthcoming.

A MEETING was held in the Town Hall, Stranraer, on Friday, the 5th January, to discuss the advisability of establishing cheese factories in the county on the American system, and a committee was appointed to inquire into the details regarding the management of the Derbyshire cheese factories, and to report at a future meeting.

M. LITTRÉ has received a letter from M. Gambetta, praising him highly for his invaluable works, and nominating him as Professor of History to the Bordeaux Polytechnic School. The letter was published by public authority in the *Moniteur*.

THE new fuel invented for Paris is more substantial than had been supposed. It is the asphalt used for coating the side-ways of the streets. The total length of *trottoirs* is about two million yards, the breadth two yards, and the thickness half an inch, so that the cubic measurement of asphalt ready for use is 555,550 cubic yards. It is mixed with about half of its weight of sand, which reduces the real weight of asphalt to 277,777 cubic yards. It is difficult to burn asphalt without being suffocated with smoke. But all these drawbacks can be met successfully by scientific skill and ability. M. Le Troost, directorof the Grenelle Gas Works, has erected furnaces for using tar as fuel in the distillation of tar. Tar is sufficient without the help of any other fuel to prepare gas for ordinary purposes or for inflating balloons. These furnaces were working successfully from the beginning of November, and this success has probably led to the idea of using asphalt as fuel for ordinary purposes.

ONE rather singular invention for remedying the actual want of fuel in private houses became very popular in Paris during the siege. They prepare cylinders of clay impregnated with bituminous substances ; these combustible cylinders are used like the ordinary charcoal which is necessary in Parisian cookery. The earthy matters, of which the proportion is not greater than necessary, remain in the furnaces like ashes left by the combustion of charcoal. It is stated that it is proposed to continue the use of this kind of artificial fuel.

THE *Academy* states that the great attraction of the geological portion of the St. Petersburg Museum consists in one entire gallery of mammoth remains, probably including many nearly entire skeletons, the bones of all of which are in a remarkably fresh state of preservation. Some years since (owing to the exertions of Sir Antonio Brady), an almost entire mammoth's skull, with tusks of colossal proportions, was obtained at the brick-pits at Ilford, in the Thames Valley brick-earth, and now adorns the geological gallery of the British Museum. Since the appointment of M. Dupont to the post of keeper in the Brussels Museum, the almost entire skeleton of a mammoth, found some time since, but neither repaired nor mounted, has been diligently mended up bit by bit, till they are able now to boast the possession of the best example of *Elephas primigenius* out of St. Petersburg. One is struck with the comparative height and slenderness of the mammoth's skeleton as compared with the modern elephant, and it seems probable that he was a more active and a lighter-built beast than the Asiatic or African species. It is to be hoped that the British Museum collection will ere long be enriched by the addition of a skeleton of the Siberian mammouth. The execution of the fortifications around Antwerp has led to the discovery, not only of elephants' and mastodons' remains, but of a most wonderful series of cetacean bones. These are now arranged in a fine gallery in the Brussels Museum, which, under the direction of M. A. de Borre, bids fair to be one of the most attractive of Continental institutions.

SHOCKS of earthquake were felt in Scinde on the 12th November.

ON the 24th October at 1.40 A.M. a smart shock of earthquake was felt at Yokohama, with a deviation from E. to S.W. The shock was remarkable for long duration.